Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/521
AUSTRALIA
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

A NEW TECHNIQUE FOR UP-GRADING AUSTRALIAN THORIUM RESOURCES

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Since Australia has virtually no workable deposits of thorium comparable with the oxide and silicate minerals of the Canadian uranium fields thorium produced locally must be obtained from monazite. Total reserves of this mineral are not accurately known but production has been increasing rapidly with the growth of industries processing beach sands for ilmenite, rutile and zircon. In 1962, 899 tons of refined monazite were produced, mainly from the ilmenite treatment plants of Western Australia. The remainder came from New South Wales and Queensland. Almost the whole of this production, together with accumulated reserves of concentrate, were exported to Europe and the United States as a high-grade product containing over 95 per cent of monazite.

Extraction of thorium from monazite has not been attempted in Australia on a commercial scale. However, ample facilities exist to do this economically if interest in Th-U^{233} and Th-Pu^{239} fuel cycles is maintained by the Australian Atomic Energy Commission or if other commercially attractive outlets arise. Many needlessly complicated processes have been proposed for this extraction while many "shortened" processes do not give a product of adequate purity in economic yield. A simplified "acid" process is now proposed in which a thorium concentrate is produced in a small number of stages with minimum quantities of inexpensive reagents. The yield of thorium exceeds 95 per cent. The concentrate contains an approximately equal weight of rare earths as carbonates or hydroxides. After its solution in nitric acid a suitable nitrate feed solution is provided for the tributyl phosphate solvent extraction process needed for refining thorium to nuclear grade.

Principal features of the process are (1) the quantitative co-precipitation of thorium with rare earths by means of recycled sodium sulphate solution; (2) conversion of the double sulphate precipitate to double carbonates by treatment with sodium carbonate solution; (3) selective leaching of the mixed carbonates with sulphuric or other acid to separate thorium from rare earths. The phosphate content of the residual thorium concentrate can be lowered, if required, by treating it with concentrated sodium hydroxide.

Rare earth salts are valuable by-products and it is pointed out that the choice at any location between this process and the most competitive "alkali" process may largely be determined by the comparative profitability of by-product sales and the marked price differential which favours the use of sulphuric acid in Australia.